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NOTES OF MONTHLY COMPONENT TEST PROGRAM REVIEW MEETING HELD WITH SNPO AT WANL ON APRIL 9, 1965

(Title Unclassified)

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Notes of Monthly Component Test Program Review Meeting held with SNPO at WANL on April 9, 1965

Attendees:

DeZubay, E. A.	WANL	Miller, A. I.	WANL
Kees, F. R.	WANL	Rowan, W. J.	WANL
Larson, L.	AGC	Salvador, L. A.	WANL
Mader, G.	AGC	Sheppard, D.	AGC
McCreary, H. S.	WANL	Tushar, H.	SNPO-C
		Wisniewski, E.	WANL

Summaries of the present status of each Experimental Engineering Component Test were presented at the April 9, 1965, Monthly Component Test Review Meeting. The following material was presented by Engineering Mechanics.

EML-60 Core Effective Gap Test

The core assembly for this test is complete. All the element seals were leak tested, all pressure probes have been checked out; pressure vessel, instrumentation and supply piping is in the laboratory being assembled for the test. During the month of April, diameter vs. bundling pressure measurements will be obtained. The parts will be installed in the test arrangement and the system checked out. Initial flow tests with helium are expected late in the month.

The nine-inch high core was used in a test to measure the effects resulting from coating on the peripheral elements of the core. Data is being collected on the force necessary to displace various elements in the core when the peripheral elements have increased thicknesses due to coating as compared with the forces required with the standard element thickness.

EML-61 Tie Rod Fatigue Properties

Eight additional tie rods were tested to failure during the month of March. Little effort was expanded in this area. Additional fatigue information was gathered with a minor investment of technician time. S-N curves are now available for 718 Inconel with mean loads of 810 lbs. and 530 lbs.

Some 750 Inconel rods will be tested in April.

It is possible that potential design modifications may be tested in April. Counterflow tie tube and short tie rod assemblies may be tested for strength capability if the test hardware is available.

EML-65 Mechanical Test of Instrumented NRX Reactor Components

The calibration of NRX-A4 lateral support springs was completed during March. Seventeen of the lateral support springs in NRX-A4 are instrumented with strain gages, each of these was calibrated. Tests were also conducted to show the effects of possible weld breaks. The instrumented tie rods for NRX-A4 may be available for testing in April. WANL-TME-1107, "Calibration of Instrumented Lateral Support Springs and Tie Rods", was published.

EML-67 Fuel Element Cluster High Temperature Testing

The high temperature cluster testing conducted in March concentrated on the incorporation of hydrogen into the small furnace testing. One cluster was tested in four successive runs to investigate the bonding between the element and the block with a hydrogen atmosphere. Three of the tests were conducted at 4500° R and 600 lb; one of the tests was conducted at 4800° R and a 600 lb. load. No welding occurred during these tests. However, some flakes

EML-67 <u>Fuel Element Cluster High Temperature Testing</u> (cont'd)

of niobium carbide and particles of uranium carbide stuck to the surface of the support block. The components used in these tests are being analyzed at this time. There was a great deal of corrosion on fixture and furnace parts. New parts are being machined at this time and will be coated to reduce the corrosion. The hydrogen used in these experiments was introduced through the center hole and fed to the undercut area between the elements by specially drilled holes in the central element.

EML-69 <u>Support Block Mechanical and Thermal Test</u>

A series of support blocks were tested during March. These tests included many support blocks which were part of the NRX-A2 assembly during its hot test as well as some new blocks. Five blocks from the NRX-A2 assembly were tested in compression at room temperature and failed with loads varying between 3700 and 4400 lbs. The average failure load was 4138 lbs. Previous room temperature tests showed an average of 4010 lbs. Three NRX-A2 blocks were tested at 4300° R and failed in compression at loads of 6600, 7600 and 7800 lbs. Two new support blocks were tested at 4300° R with compressive load taken to 9500 lbs. without failure of the block. The test was stopped at this load due to the equipment limitations. One new support block was tested for its creep characteristics during baking out of a new furnace heater. The block supported a load of 4000 lbs. at 4300° R for six hours. During the test, a separation occurred at the base of the counterbore in the block. The permanent dimensional change due to the load was .030 inches. Most of this creep occurred in the first two hours of the test. During the month of April, three more support blocks from the NRX-A2 assembly will be tested. Techniques to check the strength of support blocks with thermal gradients will be developed.

EML-70 Strip Supported Cluster Test

Many developmental tests were conducted during the month of March on cluster designs. The loads measured for various key depth assemblies were given. They varied from approximately 40 lb. for the .010 depth key to 500 lb. for the .150 depth key. The strength of internal graphite threads which were machined in fuel elements was also measured. The threaded central elements carried a load of approximately 650 lb. Six high temperature tests were conducted at 4500° R on various bonded cluster designs. Four strip supported clusters of non-fueled elements were tested and carried a load of approximately 4000 lb. Two fully bonded clusters with fueled elements carried a load of 6360 lb.

EML-73 Inner Reflector Testing

Inner reflector models (6 in. dia. x 6 in. lg. x 1/4 in. thickness) were tested for their buckling characteristics. Solid barrels withstood more than 500 psi before buckling and deflected about .1 inch. Staved models buckled at about 450 psi and deflected a large amount before failure. A complete summary of these data is being made at this time.

EML-75 Friction Tests of Reactor Components

Tests of NbC coated fuel element wafer and support block specimens were performed with and without a TaC foil separator to determine the temperatures at which bonding occurs. Tests of ten and twenty minute duration were performed in hydrogen at temperatures from 4500 to 4800° R with a 250 psi contact pressure, developed by applying a normal force of 20 lb. on specimens with a net area of 0.08 inches^2. The TaC foil separator was found to be effective in preventing bonding at the most severe conditions investigated, EML-75 Friction Tests of Reactor Components (cont'd)

4800° R for a period of twenty minutes. However, when the foil was not used, the specimens bonded in ten minute tests at 4600° R. Additional testing will be performed next month with and without a TaC foil separator to determine whether the relative motions expected between the fuel elements and support blocks during long-life reactor tests can cause coating damage.

EML-76 Reactor Hardware Static and Dynamic Tests

A series of tests were run on the components which will be used for the central element seal. This is the seal which uses pyrofoil in a chevrons backing type arrangement. The assembly dimensions were obtained. The force required to make the seal was measured (30 to 40 lb). The loading force which would burst the central element was also measured and found to be about 250 lb. or approximately an order of 92 greater than the assembly force. Additional tests are planned for April which will include measuring the characteristics of this seal at its operating temperature (approx. 1200° R). Characteristics such as preload effectiveness, creep at temperature, and friction will be measured.

EML-92 Thermal Contact Resistance Test

Several tests were conducted on a 2219 aluminum-ATJ graphite interface in helium at 50 psig gas pressure. The interfacial pressures were 10, 50 and 300 psi. The preliminary results indicate that the thermal contact coefficient increases with increasing interfacial pressures.

EML-93 Pyrolytic Foil Wrapper Test

Tests were performed to determine the ultimate strength and maximum strain of pyrofoil in hydrogen at 4500° R. In the first series of tests, measurements were made when the test temperature of 4500° R was attained. In the

EML-93 Pyrolytic Foil Wrapper Test (cont'd)

second series, the specimen was held at the test temperature for approximately 12 minutes before measurements were taken. The tensile strength measured in both cases was approximately the same - 450 to 610 psi. However, an increase in permanent set of about forty percent was measured after the high temperature dwell. This was attributed to creep during the extended exposure to test temperature.

E. A. DeZubay presented the Fluid Flow Laboratory Program as follows:

HHT-2 Hydrogen Corrosion Tests

Additional facility checkout tests on fuel elements were performed at the Waltz Mills location. The resulting data was correlated with the Large facility test results and a very close comparison found. The difference in weight losses between the two facilities averaged fractions of a gram. Average temperature differences correlated very well. The Waltz Mills hot end temperatures were approximately 50° lower than hot end temperatures recorded at the Large facility.

Direct shipments of elements from Cheswick to the Waltz Mills facility should begin during the week of April 19, 1965.

Chuck development tests were continued at the Large facility. A reversed type cold end chuck was tested and proved quite satisfactory. This chuck permits the hot end chuck to be attached to the element prior to insertion into the furnace. This was found to be necessary to obtain a hot end chuck that can follow element expansion and contraction during testing. This useable cold end chuck is the initial half of the chuck development effort. Design effort will now be concentrated on new hot end chucks.

Of the 160 tests run at the Large facility, 80 were corrosion tests for the back coating process. Mr. Larson asked if pyrometer readings were corrected to reflect the difference in sighting on graphite or niobium carbide. WANL representatives replied that they are, and that future TWX values will be so corrected. WANL representatives further reported that piping for converting to argon cooldown is about complete and should be in operation by May 1, 1965.

HHT-4 Single Cluster Test

During the month of March, four full cluster tests were performed. The cluster tested was assembled of unfueled elements with 30-mil orifices. During the most successful of these tests, a maximum sleeve temperature of 4830° R was observed at a flow rate of 1850 scfm. The test ran for a period of 20 minutes with a maximum power input of 1.43 MW. The recorded pressure drop was 152 lbs. The cluster is now being disassembled to study the effect of the test.

HHT-6 Interstitial Corrosion Tests

The first of the hot element-hydrogen runs was made during the past month. This test simulated a 2-mil gap between element faces. . All systems functioned properly for the entire 30-minute run. The temperature distribution on the specimen was fairly uniform. Exhaust gas temperature distribution maintained a constant 1000° F throughout the run. Results of the test were surprising in that evidence of corrosion occurred only at the inlet and outlet ends of the test piece. This corrosion pattern extended approximately 0.5 inches into the flow channel and approximately 0.75 inches at the outlet end of the flow channel. No corrosion was evident between these two locations. The next test run will simulate a 6-mil gap between adjacent faces.

HHT-15 Seven Cluster Thermal Tests

A layout of the heater and electrode assembly has been completed. The first build core configuration has been set as a 8 1/2-inch diameter core with a cooled periphery. Core analysis indicates that the radiant heater center element will have to be run at 6000° R to achieve the surface temperature required for this test. This is due to the use of reactor thickness pyrotiles in this build. Under present schedules, the first test will commence during November, 1965. Results will be utilized in developing the NRX-A5 and other future reactors.

FFL-17 Plugged Core Tracer Gas Tests

Following the installation and operational check-out of the tracer gas injection and sampling system and controls, a series of tracer gas tests was conducted to optimize the various parameters associated with injection and sampling. These were injection rate, core inlet pressure, sample orifice size, and time of sample acquisition. The experimental design for evaluating these parameters by analysis of variance was completed at the 300 psia core inlet pressure level with the result that none of the parameters significantly effected measured tracer gas streamline locations within the ranges studied. Therefore, these parameters were optimized on the basis of the least amount of perturbation to normal core flows (low sampling and injection rates) consistent with adequate definition of streamlines (high injection rate and long purge times prior to sample acquisition). The resulting conditions chosen for the remainder of the core mapping tests at 300 psia were (1) injection rate of 1.5×10^{-4} to 3.0×10^{-4} lb/sec, (2) sampling orifice of 3 mils, and (3) sample time of 120 seconds after steady-state conditions are attained.

Several tests were conducted in the core mapping series in which methane was injected near the top of the core at various distances from the centerline. Forty samples of the resulting methane-hydrogen mixtures were acquired during each test from probes downstream of the injection point at three azimuthal positions, five axial positions, and four radial positions. Plots of the resulting methane concentrations versus radial position provided a clear definition of tracer gas streamlines along the core. Early indications from these tests are that the main flow lines are axial with some inflow probably occurring along the periphery. These results, of course, must be corroborated by more extensive testing.